CLAIMS

1. An OTDM transmission method for implementing distortion-free transmission, wherein

an optical time-division multiplexed (OTDM) signal pulse train is converted to a spectrum sequence of wavelength division multiplexed (WDM) signal by means of an optical Fourier transform circuit for converting an optical pulse waveform in the time domain to the frequency spectral profile of the pulse;

the converted optical pulse train is incident on an optical fiber transmission line;

the WDM signal spectral sequence after transmission in the optical fiber transmission line is converted to an OTDM signal pulse train by means of an optical inverse Fourier transform circuit for receiving an optical pulse train incident on the optical fiber transmission line and transmitted in the optical fiber transmission line and converting the frequency spectral profile to the optical pulse waveform of the pulse in the time domain, to regenerate the time-domain waveform of the OTDM signal pulse train before transmission; and

the frequency spectral profile is maintained even if the transmitted optical pulse receives any linear time distortion in the optical fiber transmission line.

2. An OTDM transmission method according to Claim 1,

wherein the optical Fourier transform circuit comprises a phase modulator driven by a repetition frequency of 1/N of the transmission rate of the OTDM signal pulse train (N is an integer) and a dispersion element for giving group-velocity dispersion; and

a train of N-channel OTDM signal pulses is converted to a sequence of N-channel WDM signal spectrums.

3. An OTDM transmission method according to Claim 1 or 2,

wherein the repetition frequency R of the optical pulse train before multiplexing is used as a driving frequency for an optical Fourier transform when an OTDM signal pulse train having a repetition frequency nR as a result of multiplexing of n times is used for the repetition frequency R of the optical pulse train before multiplexing to the OTDM signal pulse train.

4. An OTDM transmission method according to Claim 1,

wherein the tolerance of the optical transmission signal with respect to either or both of dispersion and polarization-mode dispersion is increased by increasing the effective time width of the optical Fourier transform sufficiently in comparison with the time width of the input optical pulse train.

5. An OTDM transmission method according to Claim 1,

wherein a dispersion element and a phase modulator of the optical inverse Fourier transform circuit on a receiver side use the completely inverted signs of those used in the optical Fourier transform circuit on a transmitter side.

6. An OTDM transmission method according to Claim 1,

wherein the optical inverse Fourier transform circuit comprises a phase modulator for applying phase modulation to each optical pulse in synchronization with the optical pulse train and a dispersion element for giving group-velocity dispersion; and

a clock signal is extracted in accordance with the channel interval of the received WDM signal pulse train, and the phase modulator is driven by the obtained clock signal.

7. An OTDM transmission method according to Claim 7,

wherein the optical inverse Fourier transform circuit regenerates a clock signal in accordance with a beat signal corresponding to a difference in frequency between adjacent frequency channels, and the phase modulator is driven by the repetition frequency of 1/N of the clock-signal frequency.

8. An OTDM transmission method according to Claim 1,

wherein a Fourier transform-limited pulse is used as the OTDM signal pulse train.

9. An OTDM transmission method according to Claim 1,

wherein the optical Fourier transform circuit comprises a phase modulator and a dispersion element; and

the chirp rate K of phase modulation of the phase modulator and the group-velocity dispersion D of the dispersion element satisfy a relationship of K = 1/D.

10. An OTDM transmission apparatus comprising:

an optical time-division multiplexing (OTDM) signal transmitter for transmitting an optical time-division multiplexed pulse;

an optical Fourier transform circuit for converting the optical pulse waveform in the time domain to a frequency spectral profile of the pulse with respect to an OTDM signal pulse train output from the OTDM signal transmitter;

an optical inverse Fourier transform circuit for converting the frequency spectral profile of the optical pulse

to an optical pulse waveform in the time domain with respect to the optical pulse train which is incidented from the optical Fourier transform circuit to an optical fiber transmission line and transmitted in the optical fiber transmission line; and

an OTDM signal receiver for demultiplexing the optical pulse train output from the optical inverse Fourier transform circuit into low-speed optical signals and receiving at each channel;

wherein the optical Fourier transform circuit being used to convert the OTDM signal pulse train to a WDM signal spectrum sequence;

the converted optical pulse train being incident on the optical fiber transmission line;

the time-domain waveform of the OTDM signal pulse train before transmission being regenerated by converting the WDM signal spectrum sequence after it is incident on the optical fiber transmission line and transmitted in the optical fiber transmission line to the OTDM signal pulse train by means of the optical inverse Fourier transform circuit; and

distortion-free transmission being implemented because the frequency spectral profile is maintained even if the transmitted optical pulse recieves any linear time distortion in the optical fiber transmission line.

11. An OTDM transmission apparatus according to Claim 10, wherein, in the optical Fourier transform circuit,

the dispersion element gives group-velocity dispersion to the OTDM signal pulse train;

the phase modulator is driven by a repetition frequency of 1/N of the transmission rate of the OTDM signal pulse train (N is an integer), and gives linear chirp to the optical pulse

output from the dispersion element; and

the dispersion element receives the optical pulse output from the phase modulator, gives group-velocity dispersion again, and compensates for residual chirp.

12. An OTDM transmission apparatus according to Claim 10, wherein, in the optical Fourier transform circuit,

the phase modulator is driven by a repetition frequency of 1/N of the transmission rate of the OTDM signal pulse train (N is an integer), and gives linear chirp to the OTDM signal pulse train;

the dispersion element gives group-velocity dispersion to the optical pulse output from the phase modulator; and

the phase modulator receives the optical pulse output from the dispersion element, gives linear chirp again, and compensates for residual chirp.

13. An OTDM transmission apparatus according to Claim 10, wherein, in the optical inverse Fourier transform circuit,

the dispersion element gives group-velocity dispersion to the received optical pulse train;

the phase modulator is driven by a frequency of 1/N of the clock frequency regenerated from the received optical pulse train (N is an integer), and gives linear chirp to the optical pulse output from the dispersion element; and

the dispersion element receives the optical pulse output from the phase modulator, gives group-velocity dispersion again, and compensates for residual chirp.

14. An OTDM transmission apparatus according to Claim 10, wherein, in the optical inverse Fourier transform circuit,

the phase modulator is driven by a frequency of 1/N of

the clock frequency regenerated from the received optical pulse train (N is an integer), and gives linear chirp to the received optical pulse;

the dispersion element gives group-velocity dispersion to the optical pulse output from the phase modulator; and

the phase modulator receives the optical pulse output from the dispersion element, gives linear chirp again, and compensates for residual chirp.

15. An OTDM transmission apparatus according to Claim 10,

wherein the OTDM signal transmitter comprises:

a signal source for generating a repetition frequency R;

an optical modulator driven by the output of the signal source, for modulating an optical pulse having the repetition frequency R to an optical pulse signal train of a transmission rate R in accordance with transmission data; and

a multiplexer for multiplexing the optical pulse train of the transmission rate R output from the optical modulator, at a transmission rate nR;

the repetition frequency R output from the signal source being used as the driving frequency of a phase modulator of the optical Fourier transform circuit.

16. An OTDM transmission apparatus according to Claim 10,

wherein the optical Fourier transform circuit further comprises a 1/N divider for dividing the clock signal frequency of the OTDM signal pulse train in order to obtain a repetition frequency of 1/N of the transmission rate of the OTDM signal pulse train.

17. An OTDM transmission apparatus according to Claim 10,

wherein a dispersion element and a phase modulator of the

optical inverse Fourier transform circuit on a receiver side use the completely inverted signs of those used in the optical Fourier transform circuit on a transmitter side.